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# Preparation of pickering emulsions stabilized by silver nanocrystals

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## Pickering Emulsions

These unique emulsions utilise solid particles dispersed in a solution as a surfactant between two phases. The solid particles must be of an appropriate size and wettability to form a stable emulsion, as particles too large will fall from the interface and precipitate whereas smaller particles will not be large enough to disperse the interfacial tensions between the two phases. This size dependence is shown in the equation below.[1]

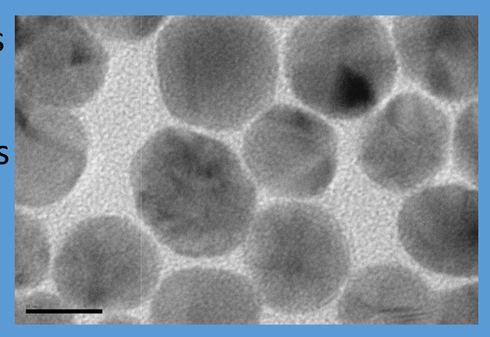
$$\Delta G = \pi r^2 \gamma_{wo} (1 - \cos\ \theta)^2$$

Due to this restriction in size it is uncommon to find examples of nanoparticles that can stabilize emulsions.

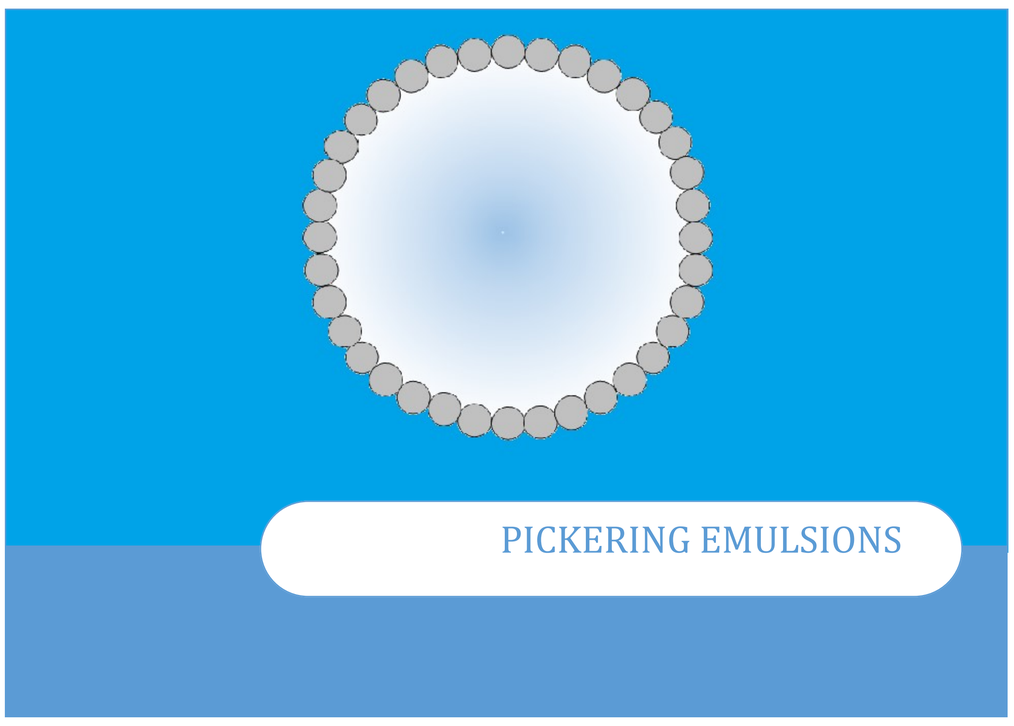
In classic emulsions a surfactant will commonly have two components: one hydrophilic and one hydrophobic to produce stability.

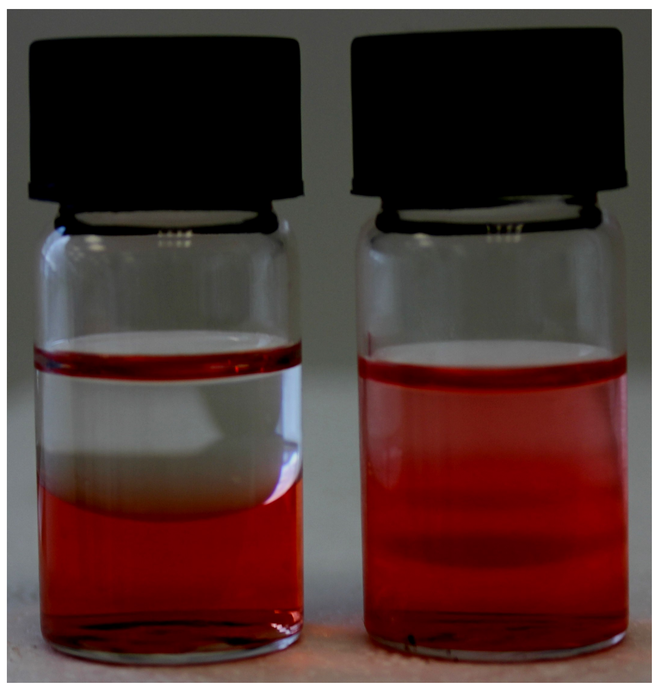
## Silver Nanoparticles

There are several routes known for producing size controlled silver nanoparticles which allow for silver particles to be made with a range of different properties, this allows for a method to be chosen to suite the application of the nanoparticles. For this purpose small spherical silver nanoparticles with a narrow size distribution is required to ensure the stability of the emulsion.



The TEM image above shows the spherical silver nanoparticles formed in this reaction where the scale bar represents 10nm.

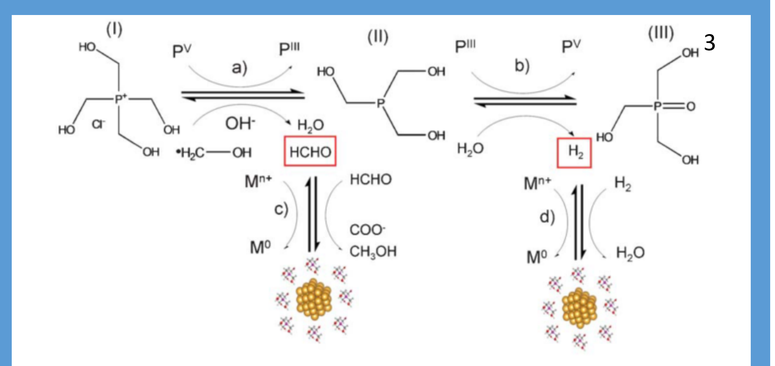


## Method

The process for producing the silver nanoparticle stabilized emulsions is adapted from an existing process for forming thin films of silver nanocrystals at the oil-water interface.[2]

$Ag(PPh_3)_3Cl$ toluene solution was placed with aqueous solutions of NaOH and THPC, resulting in the silver salt being reduced by formaldehyde and Hydrogen as shown.




**Scheme 1** Proposed reaction pathways for the generation of metal nanoparticles, involving the conversion of THPC (Structure I) into THPO (Structure III), and the *in situ* generation of formaldehyde and hydrogen as active reducing agents.

[3]

## Conclusions

This project has found a feasible method for producing relatively stable Pickering emulsions stabilized by silver nanocrystals of around 10nm diameter. The emulsion droplets when first formed tend to have an average diameter of around 1-3µm but after being left for 3 months the diameter of the droplets greatly increases through agglomeration to between 5-60µm. The emulsion was still present in the sample 3 months after preparation but with fewer and larger droplets dispersed, after this 3 month period it was also possible to again thoroughly mix the sample to attain the smaller droplet size found in the freshly prepared sample. This property allows for a preparation of the Pickering emulsion to be used multiple times or for an old preparation to be reused. The process uses widely available chemicals and simple laboratory equipment.


## References

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